PART I - ADMINISTRATIVE

Section 1. General administrative information

Title of project

Water Conservation And Stream Enhancement Project

BPA project number: 20070
Contract renewal date (mm/yyyy): ☐ **Multiple actions?**

Business name of agency, institution or organization requesting funding
Tumalo Irrigation District

Business acronym (if appropriate) TID

Proposal contact person or principal investigator:

Name	Kevin L. Crew/Karen Allen
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NPPC Program Measure Number(s) which this project addresses
Section10.2

FWS/NMFS Biological Opinion Number(s) which this project addresses
n/a

Other planning document references
Upper Deschutes River Subbasin Fish Management Plan; Middle Deschutes/Lower Crooked Wild and ScenicRivers Management Plan, Final;Draft Environmental Assessment, Central Oregon Water Conservation Demonstration Project.

Short description
Enhance in-stream flows to improve fish and riparian habitat in the Middle Deschutes River and Tumalo Creek by constructing pipeline systems to replace existing leaky irrigation canals which also pose a higher public safety risk.

Target species
Redband (rainbow) trout, mountain whitefish

Section 2. Sorting and evaluation

Subbasin
Deschutes

Evaluation Process Sort

CBFWA caucus	Special evaluation process	ISRP project type
Mark one or more caucus	If your project fits either of these processes, mark one or both	Mark one or more categories
☐ Anadromous fish ☒ Resident fish ☐ Wildlife	☐ Multi-year (milestone-based evaluation) ☐ Watershed project evaluation	☐ Watershed councils/model watersheds ☐ Information dissemination ☐ Operation & maintenance ☒ New construction ☐ Research & monitoring ☐ Implementation & management ☐ Wildlife habitat acquisitions

Section 3. Relationships to other Bonneville projects

Umbrella / sub-proposal relationships. List umbrella project first.

Project #	Project title/description

Other dependent or critically-related projects

Project #	Project title/description	Nature of relationship
9040	Central Oregon Watershed Enhancement and Outreach	complementary goals/potential for collaborative efforts

Section 4. Objectives, tasks and schedules

Past accomplishments

Year	Accomplishment	Met biological objectives?
1997	Piped 3,200 feet of the Tumalo Feed Canal, reducing losses by an estimated	Yes. In-stream flows were enhanced, thus providing for

	20 CFS. The project also enhanced flows in Tumalo Creek for approximately 9 miles by relocating the diversion of irrigation waters downstream.	additional habitat area throughout the year along the 9 mile creek section.

Objectives and tasks

Obj 1,2,3	Objective	Task a,b,c	Task
1	Reduce irrigation canal losses in the Deschutes River and Tumalo Creek, improving efficiency of out-of-stream uses	a	Incrementally design and construct irrigation system pipelines (ranging from 60-inches to 4-inches in diameter) to replace open, unlined irrigation system canals and ditches.
2	Improve the quantity and quality of fish and riparian habitat in the Deschutes River and Tumalo Creek	b	passive result of objective 1
3	Provide a safer irrigation conveyance system	c	passive result of objective 1

Objective schedules and costs

Obj #	Start date mm/yyyy	End date mm/yyyy	Measureable biological objective(s)	Milestone	FY2000 Cost %
1	7/2000	1/2001	none	Engineering	10.00%
1	3/2001	12/2002	see 1. above	Project Construction & Commencement of Passive Fisheries & Habitat Enhancement	90.00%
2					
				Total	10100.00%

Schedule constraints

Completion date
12/2002

Section 5. Budget

FY99 project budget (BPA obligated): $0

FY2000 budget by line item

Item	Note	% of total	FY2000
Personnel	Engineering/Legal/Administration	%11	2,030,000
Fringe benefits		%0	
Supplies, materials, non-expendable property		%0	
Operations & maintenance		%0	
Capital acquisitions or improvements (e.g. land, buildings, major equip.)		%0	
NEPA costs		%0	
Construction-related support		%89	16,352,000
PIT tags	# of tags:	%0	
Travel		%0	
Indirect costs		%0	
Subcontractor		%0	
Other		%0	
TOTAL BPA FY2000 BUDGET REQUEST			$18,382,000

Cost sharing

Organization	Item or service provided	% total project cost (incl. BPA)	Amount ($)
no identified sources		%0	
		%0	
		%0	
		%0	
Total project cost (including BPA portion)			$18,382,000

Outyear costs

	FY2001	FY02	FY03	FY04
Total budget	$7,878,000			

Section 6. References

Watershed?	Reference
☐	Bureau of Land Management, 1992a. Middle Deschutes/Lower Crooked Wild and Scenic Rivers Management Plan and Environmental Assessment, Draft. Prepared by BLM, Prineville District; USFS, Ochoco National Forest; and Oregon State Parks and Recreation District
☐	Bureau of Land Management, 1992b. Middle Deschutes/Lower Crooked Wild and Scenic Rivers Management Plan, Final. Prepared by BLM, Prineville District; USFS, Ochoco National Forest; and Oregon State Parks and Recreation District, December, 1992
☐	Bureau of Reclamation, 1997. Draft Environmental Assessment, Central Oregon Water Conservation Demonstration Project. April, 1997.
☐	Department of Environmental Quality, 1998. Temperature Fact Sheet, http://waterquality.deq.state.or.us/wq/303dlist/TempFactSheet.htm
☐	Marx, Steve. 1998. Personal Communication between Steve Marx, ODFW District Fish Biologist and Karen Allen, Environmental Scientist with David Evans and Associates, Inc.
☐	Moore, D., Z Willey, and A Diamant. 1995. Restoring Oregon's Deschutes River - Developing Partnerships and Economic Incentives to Improve Water Quality and Instream Flows. Environmental Defense Fund and the Confederated Tribes of the Warm Springs Reservation of Oregon.
☐	Northwest Power Planning Council, 1998. Section 2, Systemwide Goal and Framework, 1994 Fish and Wildlife Program, Northwest Power Planning Council's website http://www.nwppc.org/ftpfish.htm
☒	Oregon Department of Fish and Wildlife, 1996. Upper Deschutes River Subbasin Fish Management Plan. October, 1996
☐	Rich, Barbara. 1998. Personal Communication between Barbara Rich, Deschutes County Watershed Council Coordinator and Karen Allen, Environmental Scientist with David Evans and Associates, Inc.
☐	Walker, Tom. 1998. Personal Communication between Tom Walker, USFS Fish Biologist and Karen Allen, Environmental Scientist with David Evans and Associates, Inc.

PART II - NARRATIVE

Section 7. Abstract

The project will replace approximately 70 miles of leaky, open irrigation canals and ditches with piping ranging from 60-inches in diameter to 4-inches in diameter. Fish and riparian habitat will be enhanced through increased in-stream flows in the Deschutes River and Tumalo Creek where historical downstream summer flows have been 30 cfs

and dry, respectively. Other project benefits include significant public safety benefits, energy conservation, and decreased operating costs.

Section 8. Project description

a. Technical and/or scientific background

The technical scope and construction aspects of the Project are provided below, followed by a summary of the potential fish and habitat benefits to the Deschutes River and Tumalo Creek.

Technical Scope

Through the use of gaging and metering stations, the Tumalo Irrigation District (TID) estimates that it loses as much as two thirds of the water which it takes from its Deschutes River and Tumalo Creek supply points before it reaches the individual irrigators of the District. Water is diverted from the Deschutes River at the Bend Feed Canal in Bend and from Tumalo Creek below Shevlin Park, approximately three miles above the confluence with the Deschutes River. The loss is predominantly through percolation into the porous Central Oregon volcanic soils from the open District canals and ditches, although a smaller share may be attributed to evaporation and other minor system losses.

Based upon concern over this rate of water loss and the desire to improve efficiency of out-of-stream uses and downstream fish and riparian habitat in the Deschutes River and Tumalo Creek, in June of 1996, the Board executed a contract with David Evans and Associates, Inc. to prepare a comprehensive study of improvements by which water loss within the TID distribution system could be reduced. The study, entitled "Tumalo Irrigation District Water Conservation Project" has been completed in draft form and is currently under review by the Oregon State Water Resources Department and the United States Bureau of Reclamation.

Two documents establish maximum diversion rates from the Deschutes River and Tumalo Creek. The first is an Order from the Circuit Court of the State of Oregon for the County of Deschutes, dated February 14, 1933. The Order, which modifies the Supplemental Decree of February 10, 1928, sets maximum diversion rates from the Deschutes River for several Central Oregon irrigation districts, including the Deschutes Municipal Improvement District #1, an earlier name for TID. The diversion rates are stated by the acreage to be served per cubic foot per second (cfs) of diversion, and presume a 45% transmission loss from supply point to farm. The second is a State of Oregon Certificate of Water Right, dated May 26, 1959, which states the maximum TID diversion rates from Tumalo Creek. During the maximum delivery period from May 16 through September 15, a 0.0309 cfs per irrigated acre right applies at both the Deschutes River and Tumalo Creek including the 45% water loss component provided for in the Order and Certificate of Water Right mentioned above.

TID includes approximately 8,094 acres of water rights, with 690 acres owned and operated under a separate system by the City of Bend. The balance of 7,404 acres at 0.0309 cfs per irrigated acre equates to a 228.8 cfs water right at the Deschutes River and Tumalo Creek diversions. Based upon a fully piped system, the 45% water loss component may be assumed to no longer apply, therefore the adjusted diversion rate would be 0.0170 cfs per acre. For the 7,404 acres, this equates to 125.9 cfs.

Currently, during peak summer periods, TID has been diverting a combined flow of approximately 200 cfs from the Deschutes River and Tumalo Creek. Generally, TID uses water from Tumalo Creek first and then as the flows in Tumalo Creek decrease throughout the summer season, supplemental supply is taken from the Deschutes River diversion. As the TID system is converted from open, leaky canals and ditches to a piped system, the diversion rates from the Deschutes River and Tumalo Creek will incrementally reduce until the completion of the project. Once the entire system is piped, it is estimated that only the 125.9 cfs diversion will be required. Similarly, as the TID system is piped, incrementally less diversion will be necessary from the Deschutes River and Tumalo Creek, therefore the quantity and quality of water available to protect in-stream uses would improve as out-of-stream uses become more efficient.

The proposed piping system consists of a network of strategically located piping predominantly aligned within existing canal easements and right-of-ways and in some instances located within public road right-of-ways. Based upon the favorable system topography, the network consists of pressure piping and will provide for pressurized service to the irrigators, thus eliminating the end user requirement for individual irrigation pumping systems. In the upper reaches of the Deschutes River diversion canal commonly known as the "Bend Feed Canal", low pressure pipelines in the 60-inch diameter range would be required. In the other areas of the system 54-inch down to 4-inch low pressure and pressure pipelines would be required. The total estimated quantity of pipelines is 397,396 linear feet or approximately 75 miles. The associated total cost of survey, design, administration, legal fees, and construction, including a 15% contingency is $26,260,000.

The TID Board has taken the position that as funding becomes available, the system will be piped. Therefore, incremental implementation of the project is supported by the Board and is already in process. To date, approximately one mile of large diameter pipelines have been installed and TID has experienced a commensurate reduction in water loss.

Fish and Habitat Benefits

Current Distribution

Indigenous resident fish in the project reach of the Deschutes River and Tumalo Creek include redband trout (*Oncorhynchus mykiss*), an inland rainbow trout, and mountain whitefish *(Prosopium williamsonii*). Both have historically been found in the Upper Deschutes River subbasin. The project reaches are a part of the streams and rivers of the Upper Deschutes River subbasin that are considered the most degraded by man's

influence, which has altered riparian habitats and made management options to conserve indigenous fish species difficult (ODFW, 1996). Brook and brown trout also occur in the upper reaches of Tumalo Creek (Marx, 1998).

The distributions of redband trout in the stream reaches addressed by this project are closely related to high water temperatures caused by reduced stream flows. Redband trout prefer temperatures between 55-65 degrees F. Oregon Department of Fish and Wildlife (ODFW) has recorded peak summer temperatures of 65-67 degrees F near Bend, where a healthy population of redband trout is present. Temperatures increase downstream in association with low flows, such that few to no redbands are found below Tumalo State Park. At Tetherow Crossing in Redmond, below Cline Falls, where peak summer temperatures of 80 degrees F have been recorded, no redband trout are found. These high summer temperatures exceed water quality standards set by Department of Environmental Quality for the Deschutes Basin. Below Big Falls, the influx of cool spring water allows the fish to again flourish (Marx, 1998). Mountain whitefish are abundant in the Deschutes River, are found in lower Tumalo Creek, and tend to be more resilient to warm water temperatures than the redband trout (ODFW, 1996).

Status

Redband trout populations are considered to be depressed throughout their range. They are listed as a sensitive species by both the state (ODFW) and federal (USFWS) governments (ODFW, 1996). Redband trout is listed by the USFS as a Region 6 sensitive species (Walker, 1998). The population has decreased in the Deschutes River basin as a result of habitat degradation in association with irrigation flows, diversions, and past removal of large woody debris (Bureau of Reclamation, 1997). Increased in-stream flows as a result of this project may serve to help prevent the listing of redband trout in the Columbia Basin.

Effects of low flows

The effects of low flows during the summer months include changes in insect and trout production and river temperatures (ODFW, 1996). Many cold-water aquatic species begin to show negative physiological effects beginning at about 58 degrees F (DEQ, 1998). Low summer flows can seriously affect egg incubation and restrict juvenile trout migration (Bureau of Reclamation, 1997). High water temperatures caused by reduced stream flows result in either increased stress or mortality of fish and aquatic invertebrates. High temperatures also increase competition from nongame species that are more tolerant of warm temperatures.

Benefits of increased in-stream flows

Increased in-stream flows during the April to October irrigation season would increase both the areal extent and quality of fish and riparian habitat. The additional water would help reduce peak summer temperatures, thereby reducing fish mortality. An increase in quantity of habitat for redband trout into areas that are currently too warm for their survival is also expected. Tumalo Creek contains good potential spawning and rearing habitat that is presently dewatered during the irrigation season. Additional flows below the diversions will help maintain holes for fish and improve aquatic habitat for insects

(Bureau of Reclamation, 1997). Increased flows would also create a wider edge zone that is beneficial to variety of aquatic species.

The riparian plant community may also benefit from increases in in-stream flows. Higher summer flows and a reduced fluctuation in annual flows result in greater support of the root zone of the riparian vegetation community and may help support shallower-rooted species than are currently able to grow. Shade-producing shrubs and trees can also help moderate water temperatures, and may be supported by an increase in summer flows. Fish and riparian habitat enhancement will be a passive result of more efficient passage of irrigation waters. The resulting increases in summer flows may help spawn and ensure the success of active habitat improvement and restoration projects (see 8c).

b. Rationale and significance to Regional Programs

The Water Conservation and Stream Enhancement Project directly supports the goals and objectives of the 1994 Fish and Wildlife Program. The systemwide goal of the program is a healthy Columbia Basin that supports both human settlement and the long-term sustainability of native fish and wildlife species in native habitats. One policy of the program is to support and rebuild native species in native habitats by protecting and restoring conditions that support production of these species (NPPC, 1998). TID's piping project will help restore in-stream flows that will help decrease peak summer water temperatures and will, in turn, help rebuild populations of native redband trout.

This project directly relates to the *Upper Deschutes River Subbasin Fish Management Plan*, developed by ODFW in October, 1996 (ODFW, 1996). The plan establishes management priorities for the Upper Deschutes, including the areas that TID's project will address. ODFW identified low flows resulting from irrigation diversions in the Deschutes River from Bend (North Canal) to Lake Billy Chinook as one of three principal biological concerns. Low flows in Tumalo Creek during the irrigation season are also a primary concern.

This project also directly addresses the overall goals of the *Middle Deschutes/Lower Crooked Wild and Scenic Rivers Management Plan* (BLM, 1992b) and the Oregon Scenic Waterway Program. Twenty miles of the Deschutes River, from Odin Falls (RM 140) to the gauging station near Lake Billy Chinook (RM 140) was designated by Congress as a National Wild and Scenic River in October of 1988. In addition, the Deschutes River from Sawyer Park (RM164) in Bend to Tumalo State Park (RM158) and from Deschutes Market Road (RM157) to Lake Billy Chinook (RM120) was designated an Oregon State Scenic Waterway in 1988. One primary goal of the BLM management plan is to protect and enhance in-stream biological resources. The Oregon Scenic Waterways Program also aims to protect the free-flowing character of designated rivers for fish and wildlife and to enhance the natural, scientific, fish and wildlife values along a scenic waterway (BLM, 1992b). There are no other specific watershed assessments for the Deschutes River or Tumalo Creek below the diversions and above Lake Billy Chinook.

TID's piping project is a logical first component of a larger goal of enhancing redband trout populations and riparian habitat in the Deschutes River and Tumalo Creek. ODFW has identified increased water temperatures and wide flow fluctuations as a result of irrigation diversions as primary habitat limitations in the Deschutes River from Bend to Lake Billy Chinook and in Tumalo Creek (ODFW, 1996). Until in-stream flows are increased, other efforts to improve fish and aquatic habitat can not be realized. TID's project will result in this necessary increase in in-stream flows, mitigating losses both in place and in kind.

c. Relationships to other projects

The Bureau of Reclamation prepared an Environmental Assessment to evaluate the environmental impacts of a proposed Federal action designed to purchase conserved water from TID and reallocate water savings for in-stream beneficial uses (Bureau of Reclamation, 1997). The project is in response to the Central Oregon Water Conservation Demonstration Program's objective to allocate conserved water from irrigation to other beneficial uses, particularly in-stream uses. The project would result in comparable benefits to TID's piping project. The Environmental Defense Fund and the Warm Springs Tribes studied opportunities to develop partnerships and economic incentives to improve water quality and in-stream flows in the Deschutes River (Moore et. al., 1995).

The Bureau of Reclamation is involved in several water conservation projects in the Deschutes River basin with similar primary goals as TID's project, to improve the efficiency of out-of-stream uses. These include a basin water conservation plan, research into more efficient canal lining technologies, a study of water conservation opportunities, water scheduling using the AgriMet system, and assistance to irrigation districts on water measuring (Bureau of Reclamation, 1997).

The Water Conservation and Stream Enhancement Project complements several other projects and watershed efforts in the Deschutes subbasin. As noted in Section 3, the Central Oregon Watershed Enhancement and Outreach Project (COWEOP), funded under the BPA Fish and Wildlife Program, directly relates to TID's project through its education and monitoring components. COWEOP's focus on education about irrigation, watershed issues and monitoring can dovetail with TID's project by monitoring biological results of increased flows and by educating landowners and students about the positive biological effects and additional means of decreasing water temperatures along the Deschutes. This may be particularly useful given the large percentage of private property, 61% in 1996, along the Deschutes from Bend to Lake Billy Chinook (ODFW, 1996).

The Deschutes County Watershed Council has not yet developed an action plan for the Upper Deschutes River in the area addressed by this project, in part because low flows inhibit the potential for success of any riparian restoration efforts (Rich, 1998).

Construction of TID's piping project, and the resultant augmentation of in-stream flows may help raise the priority of the Upper Deschutes River for the Watershed Council's focus.

No projects specifically aimed at fish habitat enhancement are known to have occurred in the stream reaches downstream from diversions, however several have occurred along Tumalo Creek upstream from the diversions. ODFW and USFS have conducted several projects upstream of the feed canal headgate, including replacement of large woody debris in areas that it had been removed following the floods in 1964 and 1974 (Marx, 1998). Results of stream habitat surveys conducted by ODFW along the Deschutes River from Steelhead Falls upstream to Bend in 1993 and along Tumalo Creek from the confluence with the Deschutes upstream to Skyliner Bridge in 1992, through ODFW's Restoration and Enhancement Program, helped illuminate the effects of low flows on fish and riparian habitat (ODFW, 1996). ODFW has applied for a 250 cfs water right to retain as in-stream flows in the Deschutes River to benefit fisheries and riparian habitat that currently awaits an appeal (Marx, 1998).

d. Project history (for ongoing projects)

n/a

e. Proposal objectives

The Objectives of this project are:

1. To reduce irrigation canal losses in the Deschutes River and Tumalo Creek, improving efficiency of out-of-stream uses;
2. To improve the quantity and quality of fish and riparian habitat in the Deschutes River and Tumalo Creek;
3. To provide a safer irrigation conveyance system.

f. Methods

1. The methods applied to carry out the project would be traditional Civil Engineering and Surveying principles and practices necessary for the hydraulic analysis and design for the installation of the pipeline systems and abandonment of the existing irrigation canals and ditches. Engineering will include the development of plans and specifications necessary for the public bidding of the project. The lowest responsive, responsible bidder will be awarded the bid, and the Engineer will provide construction administrative and field observation services to monitor the compliance by the contractor with the contract documents.

2. The fish and riparian habitat enhancements due to additional in-stream flows in the Deschutes River and Tumalo Creek will be passive, and a resul tof t he methods employed for objective #1. TID would coordinate with ODFW and the BPA regarding monitoring the level of enhancements obtained over time.

3. Methods used to obtain objective #3 are a result of methods used for objective #1.

g. Facilities and equipment

The survey and engineering for the construction project will be performed using the latest equipment, software and technology. Field survey for design of the pipelines will include the establishment of a horizontal and vertical control system tieing into the State Plane coordinate system and Deschutes County Datum, respectively, using Global Positioning System and Total Station equipment. The field survey data would be downloaded into the engineering office computer network and reduced into AutoCAD 14 (or latest release) format. Plan and profile base mapping would be prepared in AutoCAD 14 on an IBM compatible network terminal and plotted on D-size sheets. The Engineer of Record will mark-up the sheets by hand and process them for upgrade by a technician on the network terminal. Similarly, written specifications would be prepared in Word 97 format on a network terminal printed on a laser printer and copied on a commercial duty copier. David Evans and Associates, Inc. has current staffing and equipment to meet the equipment needs of this project and no additional equipment would be required.

Construction would be carried out by the lowest responsive responsible bidder who would provide the equipment necessary to furnish and install the piping system in accordance with the bid documents.

The downstream enhancement of fish and riparian habitat on the Deschutes River and Tumalo Creek would be passive. As the annual flows increase, riparian habitat will improve through natural processes, therefore no equipment is necessary.

h. Budget

The project budget was derived from industry estimates of similar pipeline construction projects. The legal, engineering, and administrative components were estimated at 12% of the total construction costs. The following tables indicate the costing criteria, pipe sizing summary, and final cost estimate.

PIPE COSTING CRITERIA				
Pipe Diameter (inches)	Unit Cost ($/foot)			
	Within Existing Canal Alignment		New Alignment	
	Low Pressure	Normal Pressure	Low Pressure	Normal Pressure
4	--	15	--	30
6	--	16	--	31
8	--	17	--	32
10	--	19	--	34
12	--	21	--	36
15	--	25	--	40
18	--	37	--	42
20	--	48	--	63
24	--	65	--	80

30	--	80	--	95
36	--	91	--	106
42	--	115	--	130
48	--	150	--	165
54	100	165	120	180
60	115	190	135	205
66	130	235	150	250
72	145	285	165	300

PIPE SIZING SUMMARY (ft)					
	Within Existing Canal Alignment		New Alignment		Total
Pipe Diameter (inches)	Low Pressure	Normal Pressure	Low Pressure	Normal Pressure	
4	0	11510	0	26445	37955
6	0	1270	0	28030	29300
8	0	27740	0	41470	69210
10	0	13080	0	28245	41325
12	0	10245	0	26070	36315
15	0	27025	0	30790	57815
18	0	8670	0	15865	24535
20	0	9295	0	0	9295
24	0	9055	0	5660	14715
30	0	5255	0	0	5255
36	0	13415	0	6660	20075
42	0	6050	0	0	6050
48	0	6890	0	0	6890
54	15555	860	4230	10695	31340
60	6501	0	820	0	7321
66	0	0	0	0	0
72	0	0	0	0	0
Total	22056	150360	5050	219930	397396
PIPE COSTING SUMMARY					
	Within Existing Canal Alignment		New Alignment		
Pipe Diameter (inches)	Low Pressure	Normal Pressure	Low Pressure	Normal Pressure	Total
4		$172,650		$793,350	
6		$20,320		$868,930	$889,250
8		$471,580		$1,327,040	$1,798,620
10		$248,520		$960,330	$1,208,850
12		$215,145		$938,520	$1,153,665
15		$675,625		$1,231,600	$1,907,225
18		$320,790		$666,330	$987,120
20		$446,160		$0	$446,160
24		$588,575		$452,800	$1,041,375
30		$420,400		$0	$420,400
36		$1,220,765		$705,960	$1,926,725
42		$695,750		$0	$695,750
48		$1,033,500		$0	$1,033,500
54	$1,555,500	$141,900	$507,600	$1,925,100	$4,130,100
60	$747,615	$0	$110,700	$0	$858,315
66	$0	$0	$0	$0	$0
72	$0	$0	$0	$0	$0
					$18,497,055

FINAL TOTAL COST ESTIMATE

Pipe construction			Subtotal
	Pipe cost from Table 6-1	$18,500,000	
	Special installation through tunnel	100,000	
	Replacement of Flume No. 4	150,000	$18,750,000
Pumpstations			
	Redrock Siphon pumpstation	5,000	
	Bend Feed pumpstation	25,000	
	Klippel pumpstation	50,000	
	Tumalo Reservoir pumpstation	75,000	155,000
Pressure-Reducing Stations			
	John James	25,000	
	Walton-Collins	10,000	
	East Couch	10,000	
	Allen	10,000	
	Columbia Southern	75,000	
	West Branch	25,000	155,000
	Construction Subtotal		$19,060,000
	Contingencies (15 percent)		2,900,000
	Subtotal		21,960,000
	Engineering, legal, administrative (12 percent)		2,600,000
	Subtotal		24,560,000
	Inflation (7 percent)		1,700,000
	Total Project Estimate		$26,260,000

Section 9. Key personnel

The surveying, engineering and construction administration portions of the project will be carried out by individuals with extensive experience with projects of similar scope. The Project Manager for the project will be Kevin L. Crew, P.E. Survey will be managed by Jerry Powell, P.L.S., C.W.R.E. Fisheries and habitat enhancement coordination will be managed by Karen Allen, M.S. David Evans and Associates, Inc. may call upon a variety of staff to support the project efforts, but those Managers mentioned above will have day-to-day involvement in the project and will coordinate the work. The resumes of those managers follow.

Kevin L. Crew, P.E.
Civil Engineer

Education:	B.S., Environmental Engineering, 1987, California State University, Humboldt
Registration:	Professional Civil Engineer, OR (17425), 1994 Professional Civil Engineer, CA (45602), 1990
Professional Affiliations:	American Society of Civil Engineers Municipal Utilities Association
Honors, Awards:	A.S.C.E. Young Engineer of the Year, 1987

Mr. Crew is a civil engineer with DEA. He has 13 years of experience in project management, construction management, public presentation, and design of water, sewer, stormwater, facility, grading and transportation projects. Mr. Crew has completed large and small multifaceted projects for the public sector, including the military and private developer projects. He has also prepared a variety of engineering feasibility studies, rate studies, facility master plans and other plans and studies in support of particular projects.

Water Wonderland Improvement District (WWID) Water Master Plan and Water Management Plan, Deschutes County, Oregon
Mr. Crew served as project manager for the development of the 20-year Plan for WWID. The project included existing system inventory and evaluation, hydraulic modeling, incremental system improvement recommendations, financial analysis, base maps, conservation recommendations, and coordination with the Oregon State Health Division and Water Resources Departments. The completed Plan serves as a 20-year guide for the District while also fulfilling the various state requirements.

Tumalo Irrigation District Fish Screen and Flume Replacement Projects, Bend, Oregon
Mr. Crew served as project manager on this project which included survey design and installation of a fish screen and two inverted siphons to replace aged irrigation flumes. The fish screen was designed in accordance with Oregon State Department of Fish and Wildlife criteria within the Tumalo Irrigation District's Deschutes River diversion to prevent the entry of fish into the irrigation canal and return them safely to the Deschutes River. The siphon improvements involved design for the demolition and removal of existing aerial flumes and replacement with inverted siphon pipes with sufficient calculated hydraulic capacity to convey the Irrigation District's required flows.

City of Bend Municipal Airport Well, Bend, Oregon
Mr. Crew served as project engineer on this project which included design and installation of an approximate 75 hp, 300 gpm potable water well, submersible pump, pitless adapter, site piping, pump to waste system, chlorination system, and meter.

Southwest Hemet Interceptor Sewer System, Eastern Municipal Water District, Hemet, California
Mr. Crew served as project manager for this project, which included planning, consultant selection and management, design and construction of approximately 16 miles of sewer gravity and force main pipelines ranging from 8 to 48 inches in diameter. The completed system conveys sewer from the city of Hemet to a regional wastewater treatment facility located in the city of Perris.

Reach 4 Reclaimed Water Pipeline and Pump Station, Eastern Municipal Water District, Riverside County, California
Mr. Crew served as project manager for this project, which included planning, consultant selection and management, design and construction of approximately 13 miles of concrete mortar lined and coated steel pressure class pipeline and a 72 mgd pump station. Because of the size of the pipeline, Mr. Crew was also called upon to resolve difficult environmental, right-of-way, tunneling and utility conflict issues. The completed project serves as a wet weather relief system for excess reclaimed water.

Sun City Lift Station and Force Main Project, Eastern Municipal Water District, Riverside County, California
As project manager, Mr. Crew was responsible for planning, design and construction of a 10 mgd sewer lift station and approximately 3 miles of 20-inch discharge force main through Sun City, a retirement community. The lift station utilizes three 5,500 gpm submersible pumps and an odor scrubber system. The completed project serves to bypass the Sun City regional wastewater treatment facility and to convey the sewage to the Perris treatment facility.

Quivira Basin Sewer Lift Station, City of San Diego, California
Mr. Crew served as project manager and designer for this project. His responsibilities included field survey, design and construction of a wet well/dry well-style sewer lift station. This station, located next to Mission Bay in San Diego, lifts sewage taken in from city park restroom and administration facilities to the local gravity sewer system.

Point Loma Water Booster Stations, U.S. Navy Public Works, Point Loma, California
Mr. Crew served as project manager and designer for the design and construction of three water booster pump stations and a hydropneumatic booster to supply water to the Point Loma military facilities. The design of the pump stations included pump sizing, suction and discharge manifold design, variable frequency drives, and pump control valving.

Community Facilities District 88-3, City of Lake Elsinore, California
As project engineer, Mr. Crew was responsible for design and construction of several miles of street, sewer, water and storm drain systems for the purpose of serving the expanding needs of the northern area of the city of Lake Elsinore. Particular components of this project were the Robb Road street improvement and traffic signal project, the Rice Canyon 2.0 mg water tank, the Robb Road pump station, the Lakeshore Drive sewer lift station, and storm drain piping ranging in size from 18 inches to 120 inches in diameter.

JERRY C. POWELL
Professional Land Surveyor

Education: A.A.S., Civil Engineering, 1971, Spokane Community College

Registration: Professional Land Surveyor, Oregon (1919), 1980
Water Right Examiner, Oregon (181), 1988

Mr. Powell is a professional land surveyor with 23 years of experience. He specializes in computer-aided design and drafting systems integrated with surveying and engineering computer programs. His status as a professional land surveyor gives him the necessary insight to affectively assist clients and engineers to their mapping, drawing, and design objectives.

Experience

Cascade Lakes Highway Photographic Control Mapping, FHWA, Klamath County, Oregon
Mr. Powell was responsible for scheduling field survey crews and office technical staff for a location survey of 10.5 miles of highway in Klamath County. He coordinated field and office operations with DEA crews in Portland for preparation of final products.

Cascade Lakes Highway Photographic Control Mapping, FHWA, Klamath County, Oregon
Mr. Powell provided survey computations for a control survey of 10.5 miles of highway in Klamath County. Control mapping was done with a combination of GPS surveying and ground traverses.

Middle Fork John Day River Road, FHWA, Grant County, Oregon
Mr. Powell was responsible for scheduling field survey crews and office technical staff for a location survey of 6.7 miles of unpaved road in Grant County. He coordinated field and office operations, ensuring that each had the necessary information to complete their respective tasks.

Broken Top Planned Development, Deschutes County, Oregon
Mr. Powell was responsible for the survey computations for the retracement of four sections along the west edge of Bend. Five original corner stones were found and two pipes were recognized as the best available evidence. Mining surveys were also evaluated to restore obliterated corners.

Vulcan Power, Newberry Crater, Deschutes County, Oregon
Mr. Powell was responsible for the survey computations for the GLO retracement survey. No written records were found since the establishment of the original GLO corners. Two original corners were restored from witness trees and one line tree was recovered. Fire had destroyed the witness trees at many of the other corners searched for. A recent U.S. Forest Service timber sale appeared to have destroyed one other recoverable corner location. DEA developed a plan to identify corner evidence by researching previous ownerships.

Field Surveys, Federal Highway Administration, Grant and Klamath County, Oregon
Mr. Powell was responsible for survey computations for the Federal Highway Administration for road design at Davis Lake and Middle Fork John Day River. GLO corners were tied along the surveyed route.

Highway 140-Lakeview/Klamath Falls, Oregon
Mr. Powell was responsible for data processing of WILD field to finish data collection for 15 miles of control, right-of-way and topographic surveying. He was also responsible for preparation of detail and right-of-way maps and final construction drawings. Numerous restored GLO corners were tied to establish ownership lines on the right-of-way maps.

Crater Lake Highway, Crater Lake Boundary-Fort Klamath Falls, Oregon
Mr. Powell was responsible for data processing of WILD field to finish data collection for six miles of control, right-of-way, and topographic surveying.

AutoCAD Design Drawings, Bend, Oregon
Mr. Powell regularly uses AutoCAD and WILDsoft computer programs to produce a variety of design drawings for various projects. These have included subdivision plats, excavation, earthwork and topography plans, site surveys and various mechanical, structural, and civil engineering drawings.

Industrial Lands Mapping, Redmond, Oregon
Mr. Powell has assisted in the design of this comprehensive mapping project in preparation for digitizing and entering all information provided by the City of Redmond. This project involves 25 layers of AutoCAD information to be used for three different types of maps. Variation in the maps will include scales, information mapped, colors and pen types, plotting media and text fonts.

Valleyview Subdivison, Redmond, Oregon
Mr. Powell was responsible for design and drafting for maximum grade streets and coordination with utilities plans.

Burgess Road, Deschutes County, Oregon
Mr. Powell provided design drafting, computations and field survey services for four miles of county rural arterial in Deschutes National Forest near LaPine.

ODOT Maintenance Facility, Alkali Lake, Oregon
Mr. Powell performed field surveys, computations and drafting for a cadastral boundary and right-of-way survey for a 40-acre ODOT facility along Highway 395.

Interstate Highway 84 through Ladd Canyon, Oregon
Mr. Powell served as survey crew chief and chainman for all phases of construction on 6.5 miles of four-lane highway including stakes for slopes, culverts, grades, curbs, and right-of-way. He also did inspection during some phases of construction.

Interstate Highway 84, Meacham-Hilgard Section, Oregon
Mr. Powell provided construction inspection for 12.5 miles of concrete median barrier.

State Highway 395, Riley-Wagontire Section, Oregon
As survey crew chief for construction staking of ten miles of Highway 395, Mr. Powell also served as inspector for subgrade and base construction.

Welcome Center, Bend, Oregon
Mr. Powell performed boundary and site surveying, computations and drafting for Deschutes County for the multiagency Welcome Center along Highway 97.

Karen K. Allen
Environmental Scientist

Education:	M.S., Earth Sciences, 1996, Montana State University B.A., Environmental Sciences, 1987, University of CA, Berkeley
Other Training:	Design of Natural Stream Channels Course, 1998, Seattle, WA. Stream Geomorphology Course, 1996, Teton Science School, WY Environmental Law and Policy Course, 1997, University of WA Wetland Vegetation of Western WA Course, 1997, University of WA
Professional Affiliations:	Society of Wetland Scientists Society for Ecological Restoration Washington Native Plant Society
Publications:	Allen, K. and Hansen, K. 1998. The Geography of Exotic Plants Adjacent to Campgrounds, Yellowstone National Park, USA

Ms. Allen contributes her expertise in wetland delineation and mitigation, environmental restoration, stream processes, and biological assessments to DEA's Natural Resource group. Over the past 10 years, Karen has worked on projects involving botany, soils, stream processes, wetlands and restoration throughout the western United States. At DEA, Ms Allen is delineating wetlands, preparing wetland mitigation plans, improving fish and wildlife habitat, and assisting with environmental assessments, field biology and coordination for fiber optic cable installations for major telecommunications firms.

Experience

Fish Habitat Improvement, Mt. Hood National Forest, Oregon
Assessed fluvial geomorphology and riparian conditions in and near Clear Branch to help develop alternatives for improvement of bull trout habitat.

KBarJ Ranch Wetland and Wildlife Enhancement Project, La Pine, Oregon
Wetland verification, permitting, and assistance with design of wetland and wildlife enhancement project adjacent to the Little Deschutes River.

FTV Western Build, Portland, Oregon to Las Vegas, Nevada
Assisted with environmental assessment. Construction observation in Oregon for sensitive area issues and liason between client and land management agencies whose land was crossed by route (BLM and USFS).

Trammell Crow Company Bay Court North Property Wetland Reconnaissance, Mukilteo, WA
Vegetation Management Field Work, Upper Rogue River Valley, Oregon
Assessed vegetative conditions and management practices along roadsides for Oregon Department of Transportation in order to help develop an Integrated Vegetation Management Plan for the area.

Wetland Mitigation Site Assessment and Plan Development, WSDOT, Sumner, Washington
Managed project, assessed vegetation, soils and hydrologic conditions at a wetland mitigation site and prepared a wetland mitigation plan for impacts resulting from a new interchange along SR 167 in Sumner, Washington.

Erosion Control Consultations, Port Blakely, Issaquah Highlands, Issaquah, Washington
Provided consultations on erosion control measures for wetland impacts resulting from road crossings, construction observation for implementation of a wetland mitigation plan, and ongoing consultations on sensitive areas.

Cultus Creek Stream Restoration, Whidbey Island, Washington
Assessed hydraulic geometry (channel morphology) of Cultus Creek and helped design a 300-foot-long channel realignment to restore fish passage through a perched culvert, stabilize banks, and maintain the natural channel configuration that existed in upstream and downstream reaches.

Everett Delta Wetland Delineation for Natural Gas Pipeline, Snohomish County, Washington
Delineated wetlands and assessed wetland functions for approximately 30 miles of pipeline route in Snohomish County.

Redwest Wetland Mitigation, Redmond, Washington
Edited text and design layout for educational signage for this wetland enhancement and creation project.

Exotic Vegetation Research in Yellowstone National Park, Wyoming
Sampled vegetation, soils and disturbance, classified habitat types, and performed statistical analysis to determine the distribution of exotic vegetation adjacent to campgrounds in Yellowstone National Park.

Ditch Creek Stream Survey, Kelly, Wyoming
Surveyed Ditch Creek for geomorphic variables relevant to fish habitat, including pool/riffle sequence, pebble counts, cross-sections, longitudinal profiles and composition and cover of riparian vegetation.

Squaw Creek Watershed Reconstruction, Gallatin County, Montana
Investigated channel planform stability and riparian vegetation changes on approximately 15 miles of Squaw Creek using aerial photo interpretation and field reconnaissance. Assessed grazing impacts to stream morphology in tributary streams and made management recommendations to the U.S. Forest Service.

Merced River Riparian Restoration, Yosemite National Park, California
Assessed bank failures and planted riparian species along unstable banks of the Merced River in Yosemite Valley.

Sentinel Meadow Restoration, Yosemite National Park, California
Participated in design, mapping, monitoring, seed collection, erosion control, report writing, and supervision of corporate volunteer crews of 30 to 40 people for this restoration project that was designed to obliterate multiple trails and restore native meadow vegetation and conditions.

Section 10. Information/technology transfer

As this project is based upon a traditional pipeline construction project, tranfer of that technology does not appear to be of significant benefit. It is proposed that the downstream enhancement of the Deschutes River and Tumalo Creeks will be coordinated through the Oregon Department of Fish and Wildlife, Bend office. It is also proposed that the results of the passive enhancements to fisheries and habitat be maintained by ODF&W for dissemination to interested parties.

Congratulations!